

Amendment to the claims

Please amend the claims as shown below in the listing of the claims.

1. (Cancelled)
2. (Cancelled)
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- 23. (Cancelled)
- 24. (Cancelled)
- 25. (Cancelled)
- 26. (Cancelled)
- 27. (Cancelled)
- 28. (Cancelled)
- 29. (Cancelled)
- 30. (Cancelled)
- 31. (Cancelled)

32. (New) A CO₂ sensor comprising a pH indicator and a long-lived reference luminophore, the reference luminophore either being doped in sol-gel particles and co-immobilised with the pH indicator in a porous sol-gel matrix, or being immobilised in a separate oxygen impermeable layer and the pH indicator in a sol-gel matrix being laid over the impermeable layer.

33. (New) A CO₂ sensor as claimed in claim 32 wherein the pH indicator is selected from the group consisting of pH indicators including hydroxypyrene trisulphonate (HPTS), fluorescein, rhodamine B and other fluorescent pH indicators.

34. (New) A CO₂ sensor as claimed in claim 32 wherein the long-lived reference luminophore is selected from the group consisting of a luminescent complex, in particular [Ru^{II}-tris (4, 7-diphenyl-1,10-phenanthroline)]Cl₂, ruthenium-based compounds with α -diimine ligands, luminescent transition metal complexes with platinum metals Ru, Os, Pt, Ir, Re or Rh as the central metal atom and with α -diimine ligands, and phosphorescent porphyrins with Pt or Pd as the central metal atom or luminescent doped crystals such as manganese-activated magnesium fluorogermanate, ruby, alexandrite and Nd-Yag.

35. (New) A CO₂ sensor as claimed in claim 32 wherein the porous sol-gel matrix is selected from the group consisting of a methyltriethoxysilane (MTEOS) sol-gel matrix,

hybrid (organic-inorganic) sol-gel matrices including ethyltriethoxysilane (ETEOS), phenyltriethoxysilane (PhTEOS), n-octyl TEOS and methyltrimethoxysilane (MTMS), and UV-curable sol-gels, soluble ormosils, or hybrid polymer matrices.

36. (New) A CO₂ sensor as claimed in claim 32 wherein the luminophore is a ruthenium-doped sol-gel particle, in particular [Ru^{II}-tris (4,7-diphenyl-1,10-phenanthroline)]Cl₂-doped particles.

37. (New) A CO₂ sensor as claimed in claim 32 wherein the pH indicator and the long-lived reference luminophore are co-immobilised in a sol-gel matrix.

38. (New) A combined O₂/CO₂ sensor comprising:

(a) an O₂ sensor comprising an oxygen sensitive luminescent complex immobilised in a porous sol-gel matrix, and

(b) an CO₂ sensor comprising a pH indicator and a long-lived reference luminophore, the reference luminophore either being doped in sol-gel particles and co-immobilised with the pH indicator in a porous sol-gel matrix, or being immobilised in a separate oxygen impermeable layer and the pH indicator in a sol-gel matrix being laid over the impermeable layer, the sensor being interrogatable by an optical reader wherein the phase difference of a reference and an excitation phase signal is measured.

39. (New) A combined O₂/CO₂ sensor wherein the pH indicator and the long-lived reference luminophore are co-immobilised in a porous sol-gel matrix.

40. (New) A combined O₂/CO₂ sensor as claimed in claim 39 wherein the ruthenium-complex is selected from the group consisting of an oxygen sensitive luminescent complex such as ruthenium-based compounds with α -diimine ligands and luminescent transition metal complexes with platinum metals (Ru, Os, Pt, Ir, Re or Rh) as the central metal atom and with α -diimine ligands, and phosphorescent porphyrins with Pt or Pd as the central metal atom or luminescent doped crystals such as manganese-activated magnesium fluorogermanate, ruby, alexandrite and Nd-Yag.

41. (New) A combined O₂/CO₂ sensor as claimed in claim 39 wherein the immobilised O₂ sensor and the immobilised CO₂ sensor are coated onto the same substrate.
42. (New) A combined O₂/CO₂ sensor as claimed in claim 39 wherein the two sensors are coated onto the substrate side-by-side.
43. (New) A combined O₂/CO₂ sensor as claimed in any of claims 32, 38, or 39 wherein the substrate is selected from the group consisting of plastics materials including surface-enhanced PET, PE and PET/PE laminates, adhesive plastic labels, rigid substrate materials including glass, Perspex/PMMA, polymer materials from which DVDs are made for example polycarbonate and other polymer materials, metal, and flexible substrate materials including acetate or flexible polymer materials, paper, optical fibre or glass/plastic capillary tubes.
44. (New) A method of making a CO₂ sensor comprising :
- (1) synthesis of an Ru(dpp)₃(TSPS)₂ ion-pair comprising mixing dissolved Ru(dpp)₃Cl₂ with trimethylsilylpropane sulfonic acid, sodium salt and allowing the ion-pair to precipitate; ;
 - (2) synthesis of the particles comprising condensing the dissolved Ru(dpp)₃(TSPS)₂ ion-pair with TEOS and halting the condensation reaction with alcohol, washing the condensate with alcohol and drying the condensate; and
 - (3) fabrication of the CO₂ sensor films comprising suspending the doped reference particles in the coimmobilisation matrix solution, mixing the coimmobilisation matrix solution into a pH indicator solution which comprises a pH indicator in a quaternary ammonium hydroxide solution, and saturating the mixture immediately with CO₂ followed by deposition onto a substrate.
45. (New) A method of making a CO₂ sensor in a dual-layer configuration wherein a low oxygen-sensitivity ruthenium complex is sealed in an oxygen impermeable layer and over-coated with the HPTS-based CO₂ sensing layer.

46. (New) A method as claimed in claim 44 wherein the quaternary ammonium hydroxide is selected from the group consisting of cetyl-trimethyl ammonium hydroxide (CTA-OH), tetra-octyl ammonium hydroxide (TOA-OH) or tetra-butyl ammonium hydroxide (TBA-OH) or other quaternary ammonium hydroxides.
47. (New) A method as claimed in claim 44 wherein the pH indicator is selected from the group consisting pH indicators including hydroxypyrene trisulphonate (HPTS), fluorescein, rhodamine B and other fluorescent pH indicators.
48. (New) A packaging medium having a combined CO₂ sensor and an O₂ sensor as claimed in claim 39 formed on a surface of the medium which will lie internally of the package when the package is formed.
49. (New) A packaging medium as claimed in claim 48 wherein the sensors are formed on the packaging medium by a method selected from the group consisting of dip-coating, spin-coating, spray-coating, stamp-printing, screen-printing, ink-jet printing, pin printing, lithographic or flexographic printing or gravure printing.
50. (New) A quality control method comprising reading a combined O₂/CO₂ sensor as claimed in claim 39, formed on the internal surface of a package, with an optical reader, and determining the levels of O₂ and CO₂ inside the package in relation to a control.
51. (New) A method of screen-printing a combined O₂/CO₂ sensor as claimed in claim 39 onto a substrate comprising forcing the sensor sol through a mask or mesh and drying the substrate.
52. (New) A method of ink-jet printing a combined O₂/CO₂ sensor as claimed in any of claims 32, 38 or 39 onto a substrate comprising filling an ink reservoir of an ink-jet printer with sensor sol and printing the sensor sol onto the substrate using an ink-jet printer.
53. (New) A method of forming a gas-sensitive sensor on a substrate comprising printing the substrate with a porous sol-gel matrix comprising a gas sensitive indicator.

54. (New) A method as claimed in claim 53 wherein the gas sensitive indicator is an oxygen-sensitive luminescent complex.
55. (New) A method as claimed in claim 53 wherein the gas sensitive indicator is a pH indicator and a long-lived reference luminophore.
56. (New) A method as claimed in claim 53 wherein the gas sensitive indicator is a pH indicator and the substrate is further provided with separate oxygen impermeable layer comprising a long-lived reference luminophore.
57. (New) A method as claimed in claim 53 wherein two gas sensors are formed on the substrate.
58. (New) A method as claimed in claim 53 wherein the sensor is formed on the substrate by a method selected from the group consisting of dip-coating, spin-coating, spray-coating, stamp-printing, screen-printing, ink-jet printing, pin printing, lithographic or flexographic printing or gravure printing.
59. (New) A method as claimed in claim 53 wherein the substrate is selected from the group consisting of plastics materials including surface-enhanced PET, PE and PET/PE laminates, adhesive plastic labels, rigid substrate materials including glass, Perspex/PMMA, polymer materials from which DVDs are made for example polycarbonate and other polymer materials, metal, and flexible substrate materials including acetate or flexible polymer materials, paper, optical fibre or glass/plastic capillary tubes.
60. (New) A method as claimed in claim 53 wherein the sensor is a luminophore-based sensor.
61. (New) A method as claimed in claim 53 wherein the sensor is a colorimetric-based sensor.
62. (New) A substrate having a gas-sensitive sensor formed thereon wherein the sensor comprises a sol-gel matrix comprising a gas sensitive indicator and the sensor has been formed by printing.

63. (New) A substrate as claimed in claim 62 wherein the substrate is selected from the group consisting of plastics materials including surface-enhanced PET, PE and PET/PE laminates, adhesive plastic labels, rigid substrate materials including glass, Perspex/PMMA, polymer materials from which DVDs are made for example polycarbonate and other polymer materials, metal, and flexible substrate materials including acetate or flexible polymer materials, paper, optical fibre or glass/plastic cap.